CLAS12 Analysis and First Experiment Organization

Original “Charge” Presentation by Latifa & Jerry

January 13, 2017

With additions from Sebastian
March 2017
Recommendations of Common Tools Committee

- Complete COATJAVA reconstruction and calibration tools.
- Extend COATJAVA to include event selection.
- Create this group
  - Guide development of analysis algorithms
  - PID, momentum corrections, background subtraction, fiducial cuts
  - Higher level analysis – kinematic fitting, PWA
  - Standardize the algorithms and software.
- Create first experiment analysis review committee before the fall run to begin assessing the techniques used in the previous bullet.
- Get ready for the fall run: develop and run simulations for the experiments in Run Group A, define optimal running conditions, complete development of necessary tools, and define infrastructure to manage the work.
- Documentation and dissemination.
CLAS12 Data Analysis Scheme

1. **RAW DATA**
2. **RECONSTRUCTED DATA**
3. **DSTs**
4. **Physics analysis**
5. **PHYSICS OBSERVABLE**
6. **CCDB**
7. **Simulation**
8. **MC DATA**
9. **DSTs**

Flow of the process:
- RAW DATA → Calibration → RECONSTRUCTED DATA → Reconstruction → Event selection → COATJAVA/CLARA → Physics analysis → PHYSICS OBSERVABLE
Expert Analysis Group Membership

- Ken Hicks
- Dave Ireland
- Sebastian Kuhn
- Silvia Niccolai
- Eugene Pasyuk
- Larry Weinstein
- + Kyungseon Joo
To-Do List (The Agenda)

1. *Common Tools to do the following (DST generation)*
   - Good run, file and event selection
   - Compile list of special runs required (calibration, in/outbending, no B, H, 2.2 GeV…)
   - Helicity sorting and matching, false asymmetries
   - Beam and target polarization, dilution, polarized background
   - Luminosity
   - PID
   - Backgrounds
   - Vertex and momentum corrections
   - Fiducial cuts and acceptance
   - Detector and reconstruction inefficiencies
   - Kinematic fitting
   - Radiative corrections
   - Simulation of all of the above (GEMC)

2. *“Model” analysis notes, algorithms, checklists…*
Luminosity

Integrated Charge

Trigger Efficiency

- Current measurement
  - Cannot use Faraday Cup usual way.
  - Alternate methods and how to calibrate them

- Live time
  - Periodic clock
  - Random clock
  - accepted/total triggers
  - removal of bad beam intervals

- Stability on run-by-run basis
  - Number of Reconstructed Particles per event

- Check any nonlinear rate dependence if any.
  - take data with different luminosity

- Empty target runs

- Cluster finding electron trigger.
  - Continuous monitoring of calorimeters calibration
  - If any drift is observed recalibration is needed and new calibration parameters uploaded to trigger FPGA.

- How to measure a complex trigger efficiency

Target thickness

- Precise measurement of the cell size
- Continuous monitoring of target cell pressure and temperature
- Account for thermal contraction
- Effects of windows (empty vs. full target)
Abstract

This document describes the lessons learned on particle identification from analyses of CLAS data, and gives an overview of the typical PID procedures that are likely to be adopted for CLAS12 as well.

S. Niccolai, IPN Orsay

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Vertex and momentum corrections

Tracking Corrections For CLAS 12

Sebastian and Larry

General Philosophy

Make sure run plan contains all necessary auxiliary measurements
- Zero-field tracks for relative alignment
- Inbending and outbending field to disentangle DC displacements from magnetic field imperfections
- H runs for elastic and other exclusive channels (must also have multi-particle exclusive channels to fully cover kinematic plane, e.g. p(e,e’p pi+ pi-) or d(e,e’pp pi-)

Fix tracking **now**, not after the fact
- Optimize Kalman filter to provide best fit to measured hits (DC, SVT, μMEGAS, PreRad) including energy loss, multiple scattering and energy loss straggling as well as possible magnetic field and wire position uncertainties; incorporate actual beam position and, if appropriate, detached vertices
  - This will be improved iteratively, with data

Goal: Full set of 4-momenta and vertex positions WITH correlation matrix! Allows for determination of optimum vertex (detached or on beam) including m. sc. by considering all particles in the event. Allows for kinematical fitting of momenta by considering all particles in the event.
Simulating Malfunction – Related Inefficiencies

Steps:
- Detect inefficiency
  - hardware alarm
  - new ‘hole’ in occupancy plot
    - human-found
    - computer-found
- Identify inefficiency
  - on-line malfunction simulation

Goal: fill status table

Questionnaire:
- which group of wires is malfunctioning (or is now fixed)?
- corresponding to which piece of hardware?
- or grouping of unknown origin?
- when did the status change occur?

Steps:
- create & fit 1-d histograms of occupancy vs. component number
- create occupancy plot shapes corresponding to various malfunctions

• Detect inefficiency
  • hardware alarm
  • new ‘hole’ in occupancy plot
    • human-found
    • computer-found
• Identify inefficiency
  • on-line malfunction simulation

Simulating Intrinsic and Background – Related Inefficiencies

Steps:
- simulate data
  - merge with ‘no background’ data

Steps:
- parameterize
  - compare to data
  - iterate
The run group document should serve two purposes.

1. Summarize all information needed for anyone now and will analyze in the future. This includes experiment configuration and running conditions. Complete list of all standard tools and procedures for the analysis of this data set, how to get them and their locations. If skimming was used during Not bias data subset. Provide list of “good” and

2. Contain description, justification and validation of procedures, corrections etc.

Summary of running conditions

Dates of the run

- Beam: energy, current, radiator thickness
- Target: Material, Dimensions, Offset
- Start counter offset
- CLAS configuration if different from standard
- Trigger configuration(s), thresholds
- Anything else specific for the experiment

Calibration quality and PID

Present plots, which show calibration quality and detector efficiencies. Normalized yields matches the data.

Momentum and energy corrections and kinematics

Describe standard momentum correction, beam energy, they were obtained and demonstrate their effect. For kinematic distributions and confidence level distributions.

Cooking procedures

Document what software was used for cooking, its location and version and usage notes.

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<th>Procedure</th>
<th>Used PART bank reconstruction for the analysis. EVNT was NOT used</th>
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